

instead of with the red which is so conspicuous in *P. parmatius*. Our specimens are from New Ireland.

PAPILIO BROWNI, n. sp.

Exp. 4 in. *P. wallacei similis, sed paulo obscurior, anticis maculis intra cellulam majoribus, ea ad basin viridissima, duabus interioribus lineæ submedianæ angustioribus, maculis submarginalibus fere obsoletis; posticarum macula basali intra cellulam carente: subtus anticis maculis virescentibus et colore purpurascente in dimidio apicali absentibus; posticis maculis basalibus viridissimis, ea intra cellulam minutissima (fere obsoleta), lunulis rubris angulum analem versus majoribus.*

We have received a single female of this insect from New Ireland. The differences indicated in the foregoing description point out its specific distinctness from its close ally *P. wallacei*. Mr. Hewitson's figure of this latter species is taken from a New-Guinea specimen, and accurately agrees with an example sent us by Dr. Meyer, obtained by him in the same island (*cf.* Kirsch, Mitth. d. k. zool. Mus. zu Dresden, Heft ii. p. 113).

8. Observations on the Characters of the Echinoidea—II.
On the Species of the genus *Tripneustes*, Agassiz. By
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(Plate XLIX.)

It is with the greatest regret that I, in laying before the Society a few observations on another genus of the Echinoidea, find myself compelled at the outset to offer some remarks on the nomenclature adopted by Prof. Alex. Agassiz. No one who is engaged in the study of these complex and difficult forms can do otherwise than feel that he owes a great deal to the acuteness of the talented American naturalist; and his work will perhaps gain in value when it has been more subjected to working criticism than it has hitherto been.

As to the name which should be applied to the genus, Prof. Agassiz prefers to use the name *Hipponoë* (Gray) in place of *Tripneustes* (Agassiz); and he gives for this course reasons which I think deserve to be reprinted:—"In retaining the name *Hipponoë* of Gray, to which objections will undoubtedly be raised on the ground of *Hipponoa* having been before used by Audouin¹, and from the fact of the name alone appearing without further indications of its connexion, I am simply carrying out the principle that *Hipponoë* and *Hipponoa*

¹ Audouin & Milne-Edwards, Ann. Sc. Nat. xx. (1830) p. 156.

are two very different¹ words, and that when specimens are accessible which have served as basis for any systematic work, their results should be accepted when correct, even when they upset a nomenclature generally recognized" ('Revision of the Echini' p. 301).

Let us now see the extent of the "appearance" of this name. In the year 1840 there was published the 42nd edition of the 'Synopsis of the Contents of the British Museum;' and on page 65 we find a list of the genera of the family of the 'Echinidæ,' among which stands the name *Hipponoë*. All that we have here is a mere list, with numbers appended to indicate the table-cases in which the specimens were to be found, and that under an arrangement long since altered: it is hardly worth while to inquire when; for in the year 1841, which (although apparently by a slip) is the year ascribed by Gray himself² to the publication (if so it may be called) of his name *Hipponoë*, Louis Agassiz put out, and thus defined, the name *Tripneustes*:—

"Le genre *Tripneustes* est caractérisé par trois rangées verticales et parallèles de doubles pores dans chaque demi-aire ambulacraire et par une rangée principale de tubercules aux bords internes des plaques interambulacraires. La collerette des piquans est très-développée et la baguette fortement sillonnée d'un bout à l'autre. Ces Oursins ont de profondes entailles au pourtour de l'ouverture inférieure du test. Il se pourrait que ce genre coïncidât avec le genre *Hipponoë* de Gray, qui n'est point décrit, mais simplement cité dans le Catalogue du Musée Britannique. Dans ce cas, le nom de M. Gray devrait être préféré au mien"³.

It has been a matter of some great difficulty to make out the history of this name. In the Bibliographical list of Alex. Agassiz ('Revision of the Echini'), the only references appended to the name *Tripneustes* are, "Int. Mon. Scut." (*sic*) and "C. R. Ann. Sc. Nat. vi." The second reference is intelligible enough; and the first obviously refers to the 'Monographie des Scutelles,' published in 1841; but it is obvious that the Introduction, which deals with the "groupe des Scutelles en général," would only refer in the most incidental manner to so distant a form as *Tripneustes*; and it would have been convenient if Prof. Alex. Agassiz had given the page on which his father refers to this form: I have searched the pages of the Introduction in vain. Prof. Louis Agassiz seems to have believed that he first used it, definitely at any rate, in the preface to Valentin's 'Anatomie du genre *Echinus*' (*cf.* 'Nomina systematica generum Echinodermatum,' where we find *Tripneustes*, Agass. Monogr. Echin. 4^e livr. 1841).

Since writing the above, which I let stand for the purpose of giving an idea of the difficulties which are found in our way, there has come into my hands an unbound copy of the four parts of the 'Monographies d'Échinodermes,' by which I find that in the 2^de livraison, which contained the 'Monographie des Scutelles,' there was

¹ Different so far as that one is a "sense," and one a "nonsense" word, yet not so different but that *Hipponoë* is the French form of *Hipponoa*.

² Proc. Zool. Soc. 1855, p. 36.

³ Valentin's 'Anatomie du genre *Echinus*,' p. viii of the Preface by L. Agassiz.

published a short essay entitled 'Observations sur les progrès récents de l'histoire naturelle des Échinodermes;' and there, on its seventh page, we find these words:—"Dans un travail encore inédit sur les espèces vivantes de l'ancien genre *Echinus*, travail que je me propose de publier prochainement, j'ai établi les coupes suivantes, dont je me bornerai à citer ici les types; *Tripneustes* (*E. ventricosus*)" I do not think that there is any need to particularize such a method of detailing the history of a name in a work which is entitled a 'Revision;' but I have thought it right, while giving an account of Prof. Alex. Agassiz's method of working out his subject, to give all the material necessary for other naturalists, who desire to investigate for themselves the matter in question. That there was some good cause for confusion is evident from the fact that no less eminent a naturalist, and careful a writer than Prof. E. von Martens put out the synonymy thus:—" *Tripneustes*, Ag. 1847; *Hipponoë*, Gray, 1841; non *Hipponoë*, Audouin et Milne-Edwards, 1834 (Annelid)"¹. It will now be possible to write the synonymy thus:—

Tripneustes, L. Agassiz, 1841: p. viii of preface to Valentin's Anat. du genre *Echinus*. *Hipponoe*, Gray, 1855: P. Z. S. 1855, p. 36. *Heliechinus*, Girard, Proc. Boston Soc. of Nat. Hist. iii. p. 364 (fide Agassiz)².

Having now dealt at an almost wearisome length with the vexed and vexatious question of the name proper to this genus, it is time to pass to the consideration of the species of which it is made up. In the 'Revision' three are recognized:—*T. depressus*, A. Ag., *T. esculentus*, Leske (this appears to be the correct name for *E. ventricosus*, Lamk.); and *T. variegatus*, Leske. I now come to some observations on the specific name *variegatus*; and I will put them briefly thus:—

(1) The name *variegatus* is never used by any writer on the genus *Tripneustes* subsequent to Leske and prior to Alex. Agassiz.

(2) The names synonymous with it in the opinion of Prof. Agassiz, *sardica* and *angulosa*, are also used by Leske: the former has been applied by Lamarck, de Blainville, Des Moulins, L. Agassiz, and Dujardin and Hupé, among others; while *angulosa* has been used by de Blainville, and by Dujardin and Hupé.

(3) The order in which these forms are described³ will be shown by stating the pages on which they are found:—*Cidaris angulosa*, p. 92; *Cidaris sardica*, p. 146; *Cidaris variegatus*, p. 149⁴.

It is obvious that the name which *must* be used is *angulosus*; as to the other synonyms given by Agassiz in his list, they all appear to include forms which belong to this somewhat variable and widely distributed species.

The first species of the three, *depressus*, which has been found on

¹ Archiv für Naturges. xxxii, p. 160.

² Cf. Desor, 'Synopsis des Échinides fossiles,' Paris, 1858, p. 132.

³ Additamenta ad Kleinii dispositionem Echinodermatum. N. G. Leske. Lipsiæ MDCCCLXXVIII.

⁴ *Variegata* is stated (Rev. Ech. p. 135) to be described on p. 85 of Leske's Additamenta: p. 85 is occupied by part of the description of *T. saxatilis*; and the word *variegata* is not to be found on it!

the eastern coast of America, was first described by Alex. Agassiz, and is distinguished by its form, its small anal system, and the presence of large plates on the buccal membrane, at the point where this structure unites with the test. In his definition of the form¹, Agassiz states that "the anal system and the actinostome are comparatively smaller in the West Indian species." In support of this statement he gives, however, only one set of measurements for *T. depressus*; but they hardly bear out his proposition, inasmuch as in the specimen described by him, which had a long diameter of 127 mm., the anal system measured 9 mm. (giving a percentage value of 7.08), whereas the four values to be gained from his measurement of *H. esculenta* are respectively 15, 9.2, 8.1, and 7.9. The single specimen of *T. depressus* in the possession of the British Museum gives a percentage value of 6.6 (the anal system measuring 8 mm. and the long diameter 120 mm.). We might, indeed, imagine that a "than" had dropped out in the sentence just quoted, were it not that it does as it stands state fairly enough the comparative relations presented by the actinostome in the two forms therein mentioned. To this structure we will now turn. In Prof. Agassiz's specimens the actinal system measured 29 mm. (percentage value 22.8) in *H. depressa*, and 26.2 mm. (percentage value 22.2) in the largest specimen of *H. esculenta* of which he gives the measurements. The differences here are indeed not very great, but, such as they are, are evidence against Prof. Agassiz. As, however, my remarks are based rather on what I have been able to observe in the specimens in the national collection than on deductions from Prof. Agassiz's measurements, I am able to give in my adhesion to the statement already quoted, that the actinostome is smaller in the West-Indian species; for I find that while the British Museum specimen of *T. depressus* gives a percentage value of 25 for the actinostome, that of *T. esculentus* does not exceed 23.2, and may fall as low as 18.8 per cent.

T. esculentus and *T. angulosus*.—The diagnoses of Prof. Alex. Agassiz are notoriously difficult; but, so far as an attentive study of his remarks on these two species are of value, they appear to me to be convertible into the following propositions:—

The species *T. angulosus* is distinguished from the West-Indian *T. esculentus* by the following points:

- (i.) The tubercles are smaller in size and less in number.
- (ii.) The anal system is comparatively very large.
- (iii.) The abactinal system is more circular and less pentagonal, owing to the smaller size of the genital plates.
- (iv.) The poriferous zone is much narrower.
- (v.) The actinostome is larger.
- (vi.) The spines are much more slender.
- (vii.) The anal plates are smaller and more numerous.

The descriptions are marred by a very remarkable misprint, which states in effect that the specimens of *angulosus* measured by Prof. Agassiz have a height nearly twice as great as their long

¹ Revision of the Echini, p. 500.

diameter. Taking note of this lapse, we will first consider those statements regarding the species in which the results to be gained from an examination of the British-Museum specimens are not in complete accordance with the deductions of Prof. Agassiz:—

(1) *Comparative breadth of the poriferous zone.*—Prof. Agassiz states (p. 501, s. v. *H. variegata*) that “the poriferous zone is also much narrower.” As I found that my own measurements reversed the relation, and led me to the conclusion that it was in *T. esculentus* that the zones were narrower, I have been at the trouble of reducing the figures in the ‘Revision’ to a percentage value; and I find them to be

For “*H. esculenta*,” 10, 8·3, 8·9, 7·7.

For “*H. variegata*,” 9·6, 8, 7.

Pruned of its epithet “much” the statement of Agassiz is supported by his data. The British-Museum specimens, which I have measured, do not exhibit so great a range of variation in the width of the poriferous zone, as may be seen from the appended list:—

T. angulosus, 8, 8·2, 8·2, 8·6, 8·9, 9, 9.

T. esculentus, 7·8, 8, 8·4, 8·5.

These observations indicate that the poriferous zones are rather narrower in *T. esculentus* than in *T. angulosus*; but they really run so close that it seems to me that it is impossible to find in this character any constant or valuable point by which the two species may be distinguished.

(2) *Characters of the actinostome.*—The relative size of the actinostome in *Tripneustes angulosus* as compared with that of *T. esculentus* is one of the few points of difference to which it is, as a rule, easy to point. In connexion with it there is another character, which it is perhaps safest to speak of as a tendency: in *T. angulosus* the actinal surface is, as a rule, perfectly flat, and the actinostome is flush with it, whereas in *T. esculentus* that same surface is ordinarily a little swollen, and the actinostome is placed in a shallow concavity.

(3) *The anal system.*—It is interesting to compare the data afforded by the specimens of *T. esculentus* in the British Museum with those given by Prof. Agassiz. These latter are respectively 7·9, 8·1, 9·1, 9·2; those which are now given in the Table appended are 6·6, 7, 7·4, and 8; and they are to the point as leading us to insist a little more strongly on the comparatively smaller size of the anal system in *T. esculentus* than we should be justified in doing from a knowledge of Prof. Agassiz’s measurements alone.

(4) *Difference in the size and number of the tubercles.*—This appears to be a good character; but we must insist upon the fact that specimens of *T. esculentus* will be met with which have the median primary tubercles of the abactinal surface largely absorbed, while, on the other hand, there is in the Museum a young specimen which in the characters of its actinal and abactinal systems approximates to *T. angulosus*, but in which we find considerably well developed tubercles in the median spaces of the interambulacral areas. In

addition to this it is to be borne in mind that there is now valuable evidence as to the fact that tubercles may, and do, undergo absorption¹; so that we must not insist upon this character, where others point to the contrary species as being in our hands.

(5) *Ocular plates*.—I had hoped that these structures would present some constancy of arrangement, which would be of assistance in the discrimination of the species, inasmuch as in the great majority of specimens of *T. esculentus* two only of the ocular plates reach to the anal system (or, in other words, are not shut out from it by the meeting of the edges of the genital plates); thus of six examples all but one presented the arrangement just described, while the sixth had four ocular plates directly adjacent to the anal system. *T. angulosus* presented no such constancy; for out of nine examples there were five that had two plates touching the anal system, while the others had three plates occupying a similar position. No conclusions can, therefore, be drawn from this character.

Characteristic as is the arrangement of the pores in *Tripneustes*, it is only of assistance in the definition of the genus; when we come to any close examination we find, as indeed we might expect from what we know as to the mode of their development, that the arrangement of the pairs of pores with relation to one another varies considerably. I have noticed in large specimens of *T. esculentus* that the inner row of pores is quite regular, while the outer row is, as compared with it, irregular; in the smallest specimens the two flanking rows of pores exhibit very remarkable regularity, following one another in quite straight lines.

The specimens exhibiting a pentagonal aspect come in very large quantities from the Red Sea; but there is in the Museum a specimen from the Philippines in which this form of test is just as well marked as in any Red-Sea specimen.

There are some slight differences in the characters of the component parts of the dentary apparatus (lantern of Aristotle), which I will now proceed to indicate:—

In *T. angulosus* the epiphysis is arched and its upper edge is bevelled; the tooth is connected with the alveolus by delicate, but not very short, ascending and descending processes; the rotulæ are short and broad; and the radii end in two short processes.

In *T. depressus* the epiphyses are arched in very much the same manner as in *T. angulosus*; the inferior ascending processes are of much the same character, but the superior processes are much shorter; the radius is broadened out at its free end, but there is only a slight indentation at its extreme edge.

In *T. esculentus* the epiphysis is less strongly arched, and its upper edge is not so sharply bevelled; the tooth is connected with its alveolus by short pieces, which, above, are set nearly perpendicular to it; the inferior ones are only just seen through the triangular space, or, in other words, extend hardly at all upwards; the rotulæ are rather more delicate; and the free end of the radius is distinctly

¹ Vide Rev. of the Echini p. 265, *Arbacia punctulata*.

bifurcate, so that the two processes thereby formed are longer than in *T. angulosus*.

The species of the genus may now be briefly defined:—

T. angulosus.—Test varying greatly in form and colour, the spines short and generally white; in the majority of specimens there are well-marked bare spaces in both ambulacral and interambulacral areas; there are distinct though delicate and short ascending and descending processes connecting each tooth with its alveolus; and the radii terminate in two shorter processes. The poriferous zones are wider, the actinal system larger, and the anal and abactinal systems more extensive than in *T. esculentus*. The species has been found in the Red Sea, Mauritius, the Cape of Good Hope, Rodriguez, the Philippines, and at Cayenne.

T. esculentus.—The test is generally rounded and more constantly white or pinkish in colour; the spines, which are white, are longer than in *T. angulosus*; and the median spaces in the ambulacral and interambulacral areas are ordinarily occupied by tubercles of some size; the pieces connecting each tooth with the alveolus are shorter and more horizontal in direction; and the two processes of the radii are longer than in *T. angulosus*, while the poriferous zones are narrower, the actinal system smaller, and the anal and abactinal systems less extensive than in *T. angulosus*.

As I have only seen one specimen of *T. depressus*, it will perhaps be best to leave the statements which I made regarding it as they stand in the body of the paper.

I append a list of the localities from which the Trustees of the British Museum have received specimens.

TRIPNEUSTES ANGULOSUS, Leske.

- a. Gulf of Suez; with some spines; pentagonal in shape.
- b. Red Sea.
- c. "Mauritius."
- d. "Isle of France;" with spines.
- e. Cape of Good Hope; with spines.
- f. Isle of Masbate.
- g. Philippines.
- h. Reef of Oomaga; with spines.
- i. Rodriguez; with spines.
- j. Cayenne¹.

TRIPNEUSTES ESCULENTUS.

- a. Nassau, New Providence, W. I.
- b. West Indies; with spines.

TRIPNEUSTES DEPRESSUS.

- a. Gulf of California; with spines.

¹ This is a most remarkable locality, and I suspect very strongly that it is a slip for *Cayor*; but even in that case the locality is one from which the species has not yet been recorded.

Measurements of *Tripneustes esculentus*.

No.	Locality.	Absolute diam. in millims.	Percentage value of				
			Height.	Abactinal system.	Anal system.	Actinal system.	Pori-ferous zone.
1.	West Indies	68	51.4	12.5	6.6	25	...
2.	Nassau (New Providence).....	141	63.8	14.9	7	18.8	7.8
3.	Ditto	148	50	13.5	7.4	19	8.4
4.	?	100	45	12.2	...	23.2	8.5
5.	?	110	56.3	16.3	8	23	8
6.	A. Ag. i. ¹	28.5	53.3	20.3	10.5	35	10.1
7.	A. Ag. iv. ¹	118	56.7	16	9.2	22.2	7.7

Measurements of *Tripneustes angulosus*.

No.	Locality.	Absolute diam. in millims.	Percentage value of				
			Height.	Abactinal system.	Anal system.	Actinal system.	Pori-ferous zone.
1.	Masbate	29	55	17.25	8.6	34.5	8.6
2.	Masbate	67	49	16.4	29.8	8.2
3.	Masbate	77	54.5	15.5	24.6	9
4.	Gulf of Suez	89	57.2	15.7	10	25.3	8
5.	Gulf of Suez	100	56	18.5	10	26	9
6.	Gulf of Suez	109	53.2	17.4	10.5	26.2	8.2
7.	Cayenne.....	58	60	14.6	...	28.4	9.5
8.	?	95	52.6	17.9	7.9	25.2	9.4

EXPLANATION OF PLATE XLIX.

Dentary Apparatus of *Tripneustes*.

Fig. 1. A pyramid of *T. angulosus*, showing *d*, the tooth, *e*, the epiphysis.

2. Ditto of *T. esculentus*.

3. Ditto of *T. depressus*.

1 *a*. Side view of alveolus of a pyramid of *T. angulosus*, with *e*, the epiphysis, *d*, the tooth.

2 *a*. Ditto of *T. esculentus*.

3 *a*. Ditto of *T. depressus*.

1 *b*, 2 *b*, 3 *b*. Rotulæ of the three species.

1 *c*, 2 *c*, 3 *c*. Side view of radii.

1 *d*, 2 *d*, 3 *d*. Free terminal portion of the radii.

¹ I add two measurements from Prof. Agassiz for the purpose of comparison; it will be seen that the second set agree very well with my results.